

# Epidemiological analysis of coronavirus disease 2019 in Saudi Arabia

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**ABSTRACT**

**Introduction:** Coronavirus disease 2019 (COVID-19) was recognized as the reason of a group of respiratory infections in Wuhan, China. It spread quickly, leading to an epidemic followed by a worldwide pandemic. **Materials and methods:** This is a descriptive observational study depends on the daily report released by ministry of health (MOH) in Saudi Arabia regarding COVID-19 including: total number of new cases, new cases in each city, recovery cases and mortalities. This study analyzed the situation of COVID-19 from March 2<sup>nd</sup>, 2020, to May 7<sup>th</sup>, 2020. **Results:** First case was reported on 2<sup>nd</sup> of March 2020; the curve of new cases had an abrupt marked increase in the middle of April due to mass testing. As of 7<sup>th</sup> of May 2020, Saudi Arabia reported 33731 cases with incidence rate of (96.88/100000) and most of the new cases were reported in Makkah 7261 (21.5%). **Conclusions:** COVID-19 is a rapidly spreading virus. Saudi Arabia recorded the largest number of cases reported in a single Arab country. Mass testing has a significant increase of reporting new, recovery and death cases.

**Keywords:** Epidemiological, analysis, COVID 19, Saudi Arabia.

**1. INTRODUCTION**

Coronavirus disease 2019 (COVID-19) is a disease caused by a new coronavirus now called severe acute respiratory syndrome coronavirus 2. This novel virus was known for the first time during an epidemic of respiratory disease patients in Wuhan City, China (CDC, 2020). It was initially reported to the world health organization (WHO) on December 31, 2019. On the 30<sup>th</sup> of January, 2020, the WHO stated that the COVID-19 is a worldwide health emergency outbreak (NYT, 2020; WHO, 2020). Saudi Arabia announced that the first case of the new coronavirus (COVID-19) was confirmed on March 2nd, 2020, in Al-Qatif in a citizen returning from Iran in the Al-Qatif region (Al-Tawfiq et al., 2020). On March 11th, 2020, the WHO declared COVID-19 a global pandemic (NYT, 2020).

Globally, more than 1,000,000 persons were tested positive for COVID-19 on April 4th, 2020, with reporting of more than sixty thousand deaths and confirmed cases by investigations that has been reported in more than 180 countries (WHO, 2020). As with other respiratory viruses, such as influenza and rhinovirus, COVID-19 can be transmitted through respiratory droplets from coughing and sneezing and droplets generally cannot spread more than 6 feet (CDC, 2020; Van Doremalen et al., 2020). The particles of the virus have varying degrees of infectivity because they can live on different surfaces for variable durations. One of the studies showed the viability of the virus on different surfaces, thus finding that no viable viruses were measured after the passage of four hours on a copper surface or after one day on cardboard surface (Van Doremalen et al., 2020). It was agreed that the time interval between the exposure to the virus and the appearance of symptoms of COVID-19 is thought to be within fourteen days after exposure, with most cases occurring around four to five days following exposure (LiQ et al., 2020). The clinical picture of COVID-19 infection ranges from a symptomatic to mild symptoms as cough and fever and critical symptoms as severe respiratory distress but many of the patients have no severe symptoms (Chan et al., 2020).

In Saudi Arabia, there is a certain criterion in the suspicion of COVID-19 which include: sudden onset of fever, cough or shortness of breath and positive history of at least one of the following situations in the prior 14 days; history of travel, has been or stayed in an area with high risk for COVID-19 in the kingdom, close contact with a confirmed case or working in a health care facility. Some may be asymptomatic but has positive history of the previous situations. Also, there is a high suspicion in a patient who presents with an unexplained acute Respiratory illness; with negative tests for Influenza and MERS-COV and in immunocompromised patients. If a person suspects they are affected at home; they should wear a mask to minimize the possibility of transmission and call 937 to be directed to the nearest hospital. Then, the approach in handling the case depends on the symptoms; if asymptomatic but positive history of travel or contact, they are encouraged to do a home quarantine for 14 days with no contact with others or wear a mask when they do so. If symptomatic, they should go to the hospital (Saudi Ministry of Health, 2020). Our aim is to analyze the epidemiology of COVID-19 in Saudi Arabia including discussion of actions were taken by Saudi Arabia government.

## 2. MATERIALS AND METHODS

This is a descriptive observational study that aims to observe and analyze the daily reports that include statistics of COVID-19 cases since the first case report on 2<sup>nd</sup> of March to 7<sup>th</sup> of May, 2020. The daily report of Coronavirus COVID-19 in Saudi Arabia includes the following: total number of new cases, number of new cases in each city, total of recoveries and mortalities. Additionally, further detailed to the number of cases, related to traveling and were quarantined since arrival, the number of people who were infected by direct contact with previous cases and the total of cases in Saudi as well. Moreover, the records also include the daily update of global cases which include the total cases, recoveries and mortalities. The effects of Saudi interventions and precautions that took an important role in the control of the spread of COVID-19 will be analyzed as well.

The total population of Saudi Arabia in 2019 is 34,218,169 people. Saudi Arabia a big country consists of 13 administrative regions. Each region is divided into 134 governorates. The number differs from one region to another, and each governorate is furtherly divided into sub-governorates (General authority for statistics, 2020; Unified National platform, 2020). In Saudi Arabia diagnosis of COVID-19 is done by Real Time Polymerase Chain Reaction (RT-PCR). Samples are collected from the upper or the lower respiratory tracts, but lower respiratory tract samples are preferred if a patient has signs or symptoms of lower respiratory tract infection. If lower tract samples cannot be done or not indicated; upper respiratory samples are collected. Lower respiratory tract sampling includes: bronchoalveolar lavage, tracheal aspirate or sputum, if the patient is producing sputum. Upper respiratory tract sampling includes the collection of a nasopharyngeal swab, oropharyngeal swab or nasopharyngeal wash/aspirate. After that, samples are stored at 2-8°C and on an ice pack to be shipped. They can be stored for ≤48 hours and if longer time for storage is needed; they have to be stored at -70 °C. Hence if the sample is frozen at -70°C, it is shipped on dry ice. Sample handling and laboratory work is done in a laboratory that has a certified Class II BSC and a room with negative pressure in a BSL-2 facility. Thus, laboratory tests can be done in the MOH, Governmental non-MOH and private sectors hospitals that have the previous requirements. If these requirements are not available or if the results were inconclusive or indeterminate, then the sample should be registered in HESN sent to the National health laboratory (NHL) with the request attached to the sample for further testing. The number of all tested samples is reported to the public health authorities daily. As well as positive cases those are reported immediately to the public health authorities through HESN. All positive sample results from different health sectors including Governmental, private Sectors and other health care facilities should be sent to NHL, and for further confirmation; they can be sent to Saudi CDC (Weqaya, 2020).

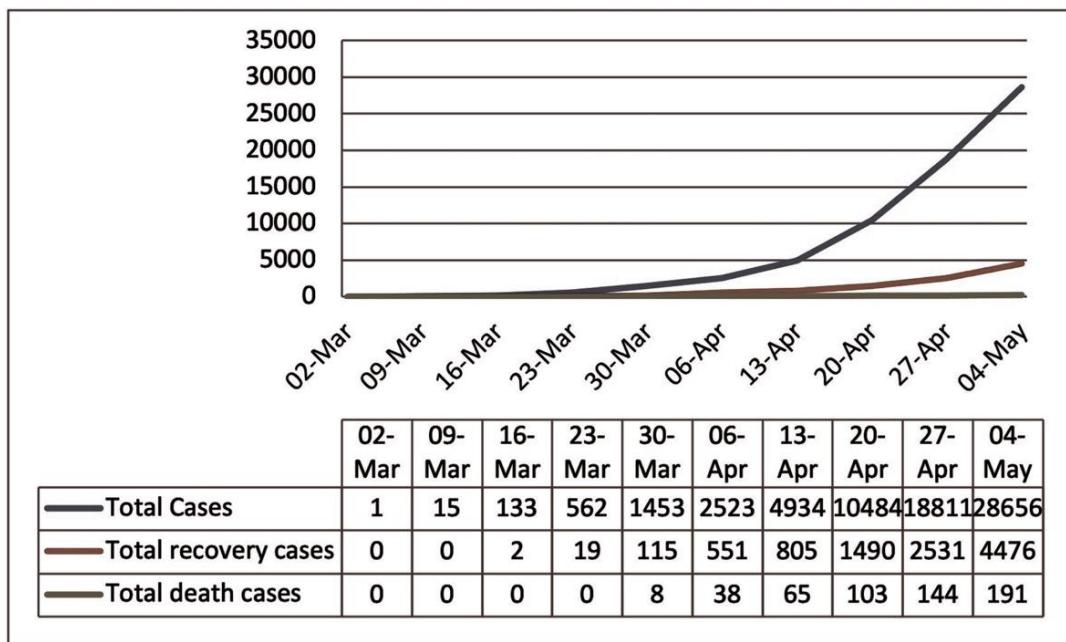
Data analysis was done using IBM advanced SPSS statistical package version 20. To analyze the effect of mass testing on the reported cases, t-test was used to compare means of the cases and  $P < 0.05$  was considered statistically significant.

### 3. RESULTS

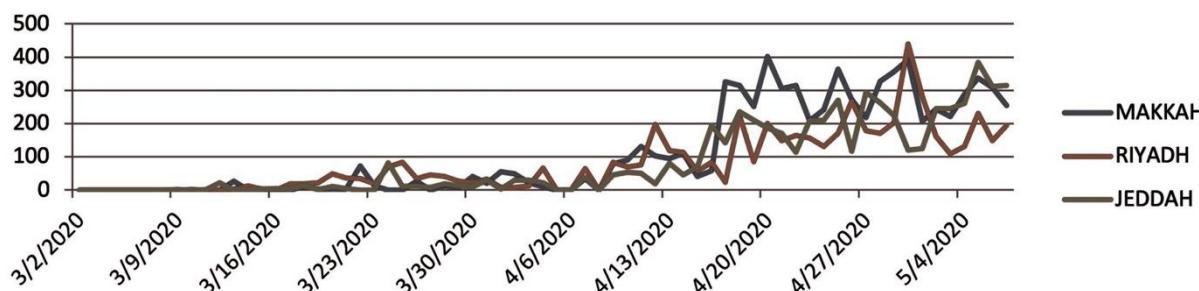
Saudi Arabia reported the first case on 2<sup>nd</sup> of March 2020; the curve of new cases reporting started to increase with abrupt marked increase in the middle of April due to mass testing. Reporting of the first recovery case was on 10<sup>th</sup> of March and started to increase in the middle of April. The first death was reported on 24<sup>th</sup> of April (Figure 1). As of May 7<sup>th</sup>, 2020, there were 7261 cases reported in Makkah accounting for 21.5% of the total cases in Kingdom of Saudi Arabia (KSA), followed by Jeddah, which reported 5574 (16.5%) of the total cases (Table 1).

**Table 1** Distribution of the total number of cases at top 10 Saudi cities.

City	Cases No (%) total cases (33731)
MAKKAH	7261(21.5%)
JEDDAH	5574(16.5%)
RIYADH	5344(15.8%)
MADINAH	5271(15.6%)
DAMMAM	2252(6.6%)
AL HUFOF	1502(4.5%)
JUBAIL	1338(3.9%)
KHOBAR	698(2.1%)
AL TAIF	690(2%)
BAISH	521(1.5%)



**Figure 1** New, recovery and death cases in Saudi Arabia from 2nd of March 2020 - 4th of May 2020



**Figure 2** Registration of new cases through 2nd March 2020 to 7th May 2020 in the top 3 Saudi cities

There is no stationary city to be on the top of new cases reporting (Figure 2). On comparison, the Gulf area countries which have the same atmosphere it were found that Saudi Arabia had the highest reported cases (33731), Oman had the lowest reported cases (2958), Qatar had the highest incidence rate (655.66/100000) while Oman had the lowest incidence rate (57.92/100000) and had incidence rate of Saudi Arabia is (96.88/100000). UAE reported the highest death rate (96.88/100000) and Saudi Arabia reported death rate of (0.62/100000) while Oman had the lowest incidence rate (0.29/100000). Mass testing has significant effect on reporting of new, recovery and death cases. Mean and standard deviation of new, recovery, and death cases were ( $151.95 \pm 175.57$ ,  $22.25 \pm 28.35$ ,  $1.85 \pm 2.40$  respectively) which increased after mass testing to be ( $1347.57 \pm 223.59$ ,  $384.33 \pm 403.31$ ,  $6.76 \pm 1.92$  respectively) with p value of 0.000 (Table 2).

**Table 2** New, recovery and death cases pre and after mass testing

	Before mass testing	After mass testing	P
	Mean Std	Mean Std	
New cases	$151.95 \pm 175.57$	$1347.57 \pm 223.59$	0.000
Recovery	$22.25 \pm 28.35$	$384.33 \pm 403.31$	0.000
Death	$1.85 \pm 2.40$	$6.76 \pm 1.92$	0.000

#### 4. DISCUSSION

Middle East Respiratory Syndrome Coronavirus (MERS-CoV) had a huge impact on the health care system in the Middle East since 2012; when the first case was reported and Saudi Arabia was the site of the world's most significant MERS-CoV outbreak. Two of the columns of Islam are Umrah pilgrimage and Hajj. This annual mass gathering happening in KSA is considered as one of the largest habitual mass gatherings in the world (Al-Tawfiq et al., 2014). Saudi Arabia welcomes Muslim pilgrims from more than 180 countries, in addition to the non-pilgrim air traffic (39 million people in 2018) (Ebrahim and Memish, 2020).

In 2019, KSA received 7.5 million Umrah visa holding visitors, additionally welcomed Saudi national pilgrims, the large migrant worker population residing in KSA, and those from visa-free countries such as the Gulf Cooperation Council (GCC) Countries. Hajj is considered the "larger" pilgrimage compared to Umrah and is considered one of the largest mass gatherings worldwide as over 3 million pilgrims were recorded on 5-days (Memish et al., 2019). Umrah visitors spend on average 10 days in the holy sites. 43% of pilgrims are 56 years of age or older, two-thirds of pilgrims are from countries with suboptimal disease surveillance systems or travel health counseling services, and 50% have pre-existing chronic disease (Ebrahim et al., 2009).

With the progression and spread of the new coronavirus (COVID-19) worldwide, KSA has taken actions to address the unprecedented effects and consequences of the disease. Saudi Arabia's Government has taken some precautions before reporting confirmed cases. On February 6<sup>th</sup>, they suspended traveling to China for all citizens and residents. As on February 27<sup>th</sup>, and for the first time for more than 70 years and in the history of Muslim pilgrimage to the holy sites, the government suspended the entry to Saudi Arabia, specifically to Makkah for Umrah purposes and Al-Madinah for the Holy Mosque; tourists were not allowed either. Moreover, they've suspended the use of national ID cards for traveling to other countries in order to track the previous visited countries (Ahmed and Memish, 2020; Gautret et al., 2020).

On March 2<sup>nd</sup>, Saudi Arabia announced the first confirmed case of the new coronavirus (COVID-19) in Al-Qatif in a citizen returning from Iran in the Al-Qatif region, Eastern KSA, and 51 contacts tested negative. Since then, the government has been taking several strict precautions in order to limit the spread and prevent the progression of an outbreak. On March 4<sup>th</sup>, the government decided to suspend Umrah for citizens and residents. The Ministry of Education announced the suspension of

education in schools and universities in Al-Qatif as a consequence of reporting several confirmed cases of the disease there on March 7<sup>th</sup>. Later on, the government announced a lockdown on Al-Qatif and held the work in private and public sectors. Furthermore, the Ministry of Education announced the suspension of education for schools and universities in the whole kingdom on March 8<sup>th</sup>. Following that, multiple decisions were announced regarding the suspensions; for instance, the events in wedding halls and hotels were held by March 12<sup>th</sup>. Suspension of international flights was then done by March 14<sup>th</sup>.

On March 15<sup>th</sup>, the government also announced the suspension of work in public sectors so as closing malls, restaurants, and public gatherings in parks and beaches. In order to decrease the incidence of public gatherings, the Ministry of Islamic Affairs announced the suspension of the Juma'ah prayer and other prayers in all mosques, including the Holy Mosque, on March 17<sup>th</sup>. Hence, on March 20<sup>th</sup>, the domestic flights, buses, taxies, and train services were suspended. Additionally, the imposition of curfew from 7 PM to 6 AM in the kingdom was done on March 23<sup>rd</sup> and the lockdown of Makkah, Al-Madinah, and Riyadh was on March 24<sup>th</sup>, expediting the curfew time to 3 PM in these cities and in Jeddah. On March 30<sup>th</sup>, the government announced that there is no cost for the treatment of the disease for citizens, legal and illegal residents. The last decision regarding this virus was taken on April 2<sup>nd</sup> is the imposition of curfew for 24 hours in Makkah and Al-Madinah (WHO, 2020).

On the 7th of May 2020, approximately 120 cities in Saudi Arabia have at least reported one positive case of COVID-19. The total cases are 33731 which is considered the largest number of cases was reported in a single Arab country, most of the new cases were reported in Makkah 7,261 (21.5%). the incidence rate was 96.88 (as calculated per 100,000 population) and the mortality rate was 0.62 (as calculated per 100,000 population) (Saudi center for disease prevention and control, 2020). Out of 33731 cases 25714 were active cases and 145 were in critical conditions. Of the new cases 25% were Saudis and 75% were non-Saudis. Total death cases were 219 and total recovery cases were 7,798. The mortality rate is considered low when comparing it with mortality rate of MERSCO in ICU patients in Jeddah on 2014 (Garout et al., 2018).

When comparing Saudi Arabia internationally, on May 7<sup>th</sup>, the total cases worldwide were 3,779,367 the recovery cases were 1,255,409 and the death cases were 265023. The top 3 countries worldwide that have the highest COVID-19 cases are: The United States with 1,257,023 cases, Spain with 221,447 cases and Italy with 215,858 cases (Saudi center for disease prevention and control, 2020). In contrast to Saudi Arabia, the incidence rate in the US was 379.76 with 22.85 mortality rate. While in Spain, the incidence rate was 473.63 with mortality rate of 55.75 and for Italy the incidence rate was 357.01 with 49.54 mortality rate. As for China, the total cases were 83,975, the incidence rate was 5.83 while the mortality rate was 0.32 (Saudi center for disease prevention and control, 2020). On the other hand, the lowest number of COVID-19 cases was reported in Western Sahara which is located in Africa with total cases of 6, incidence rate is 1 with 0 mortality rate (Saudi center for disease prevention and control, 2020). Among the Gulf area, number of population plays an important role in the variability of incidence and death rates. As Saudi Arabia has the highest population with low incidence and death rates. On the other hand, Qatar has reported a very high incidence rate and that may be due to the low number of population which is only 2,881,053 (Worldometer Population, 2020). The low death rate in Saudi has been affected by many factors, including the precautions that have been done very early since the start of the disease. Moreover, giving the fact that most of the critical cases and death are related to the elderly; the majority of populations in Saudi are children and adults.

As a precautionary procedure in Saudi Arabia, extended testing took place in order to discover new cases and limit further outspread of the disease; therefore, restricting the surge of new cases. During the middle of April, extended testing started with its first stage which is referred to as "Mass Testing". At first, it started in Makkah and Medinah, health workers and volunteers went to several neighborhoods; that are considered crowded, low socioeconomic status and that include labour worker residence. This stage involved examining and taking samples after measuring their temperature and a brief history of contact with confirmed cases. Some of these neighborhoods are known to have the highest number of COVID-19 cases; so further testing of other residents was essential. The result of the mass testing revealed the effectiveness of this process, as 762 cases were reported on the 17th of April 2020; more than 50% of these cases were in Makkah and Medinah. Following that, the continuity of the Mass Testing in other different cities and neighborhoods contributed to a significant increase in the daily reported cases.

A lot of cities in Saudi Arabia have reported COVID-19 cases, but the numbers differ from one city to the other and from one day to the other. Based on this concept, the top cities which are affected are not constant and they change every day. Many factors are considered to affect this result, such as: travel, contact with COVID-19 cases and crowding. In the beginning, the majorities of the reported cases were non-Saudi people and were strongly associated with history of travel or contact with other travelers who were confirmed as COVID-19 cases after that. Crowding contributed the most as it is considered one of the routes of contact with unknown suspected cases. It involves family gatherings, weddings, funerals and crowded places outside as the supermarket and hospitals. What proves that it is the most contributors in this crisis; is the dramatic rise in the cases after the curfew was removed or

shortened in certain cities. Other factors also include mass testing of highly suspected areas and working at a health care facility, whether a health worker or an administrative worker.

## 5. CONCLUSION

The COVID-19 is rapidly spreading virus. Saudi Arabia recorded the largest number of cases reported in a single Arab country. Saudi Arabia has taken actions to address the unprecedented effects and consequences of the disease for example it was the first time for more than 70 years and in the history of Muslim pilgrimage to the holy sites, the government suspended the entry to Saudi Arabia, specifically to Makkah for Umrah purposes and Al-Madinah for the Holy Mosque. Additionally, started mass testing which increases the recorded new cases.

### Authors' contributions

Mohammed Garout: Final Rivew of the data and final editing.

Reda Goweda: Statistical analysis, Figures and tables

Magda Abdelwadood: Analysis of the collected data, Statistical analysis and calculation of the results.

Naghm Abdul Rahman: Analysis of the collected data, Statistical analysis and calculation of the results.

Mariah Alahmadi: Literature review of previous studies, Data collection, Analysis of the collected data, Statistical analysis and calculation of the results, Writing an introduction, methodology and discussion.

Reema Abuyabis: Literature review of previous studies, Data collection Analysis of the collected data, Statistical analysis and calculation of the results, Writing an introduction, methodology and discussion.

Raha Bogari: Literature review of previous studies, Data collection Analysis of the collected data, Calculation of the results, Writing an introduction, methodology and discussion.

Kawlah Samarin: Literature review of previous studies, Data collection, Analysis of the collected data, Statistical analysis and calculation of the results, Writing an introduction, methodology and discussion.

Sarah Filimban: Literature review of previous studies, Data collection, Analysis of the collected data, Statistical analysis and calculation of the results, Writing an introduction, methodology and discussion.

Ahmed Faisal: Statistical analysis and calculation of the results, Writing an introduction, methodology and discussion.

### Ethical approval

This study was approved by the Ethics and Research Review Committee of Umm Al-Qura Faculty of Medicine before starting the study (HAPO-02-K-012).

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### Conflicts of interest

The authors declare that they have no conflict of interest.

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### Data and materials availability

All data associated with this study are present in the paper.

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